MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Ordinary Level

Paper 1 Multiple Choice

October/November 2017

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, Centre number and index number on the Answer Sheet in the spaces provided unless this has been done for you.
DO **NOT** WRITE IN ANY BARCODES.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page 15.
A copy of the Periodic Table is printed on page 16.
The use of an approved scientific calculator is expected, where appropriate.

21 Bromine is a liquid at 20 °C.

What is the melting point and the boiling point for bromine?

	melting point / °C	boiling point / °C
A	–22	–3
B	–8	–33
C	–7	59
D	25	103

22 The results of three tests on a solution of compound Z are shown.

test	result
aqueous sodium hydroxide added	white precipitate formed, soluble in excess
aqueous ammonia added	white precipitate formed, soluble in excess
aluminium and aqueous sodium hydroxide added, then warmed	colourless gas, which turns damp red litmus paper blue

What is Z?

A lead(II) carbonate

B lead(II) nitrate

C zinc carbonate

D zinc nitrate

23 An atom of potassium is represented as $^{40}_{19}K$.

Which row shows the number of protons, neutrons and electrons in the atom?

	protons	neutrons	electrons
A	19	21	19
B	19	40	21
C	21	19	19
D	40	21	40

24 Sodium chloride is an ionic compound.

Which statement about sodium chloride is **not** correct?

A Sodium ions and chloride ions are oppositely charged.

B Sodium chloride has a high melting point.

C Sodium chloride solid conducts electricity.

D Sodium chloride solid exists as a lattice.

25 Iron(III) sulfate is composed of Fe^{3+} and SO_4^{2-} ions.

Which values of x and y in $Fe_x(SO_4)_y$ give the correct formula of iron(III) sulfate?

	x	y
A	2	2
B	2	3
C	3	2
D	3	3

26 Glucose has a relative molecular mass, M_r, of 180.

How many grams of glucose are added to $50\,cm^3$ of water to make a solution of concentration $0.4\,mol/dm^3$?

A 3.6 **B** 9 **C** 36 **D** 72

27 A student adds an aqueous solution of sodium hydroxide to a solution of hydrochloric acid.

There is an increase in the temperature of the mixture.

Which row describes the reaction?

	type of reaction	energy change
A	endothermic	energy given out to surroundings
B	endothermic	energy taken in from surroundings
C	exothermic	energy given out to surroundings
D	exothermic	energy taken in from surroundings

28 Which row describes what happens during an oxidation reaction?

	hydrogen	electron
A	gain	gain
B	gain	loss
C	loss	gain
D	loss	loss

29 Flowers of a hydrangea bush are blue when grown in acidic soil and pink when the soil is alkaline.

Which substance is added to the soil of a hydrangea with blue flowers so that it produces pink flowers?

A calcium hydroxide

B citric acid

C copper(II) sulfate

D sodium chloride

30 The solubility of some salts in water is shown.

soluble	insoluble
barium chloride	barium carbonate
barium nitrate	barium sulfate
sodium chloride	
sodium nitrate	
sodium sulfate	

Which aqueous solutions are mixed to prepare an insoluble salt?

A barium carbonate and sodium chloride

B barium nitrate and sodium chloride

C sodium nitrate and barium chloride

D sodium sulfate and barium nitrate

31 Which statement about the elements in the Periodic Table is correct?

A Elements are arranged in order of their nucleon number.

B Elements are arranged in order of their proton number.

C The period number is related to the number of electrons in the outer shell.

D The reactivity of Group I elements decreases down the group.

32 Which statement about the properties of chlorine, bromine and iodine is correct?

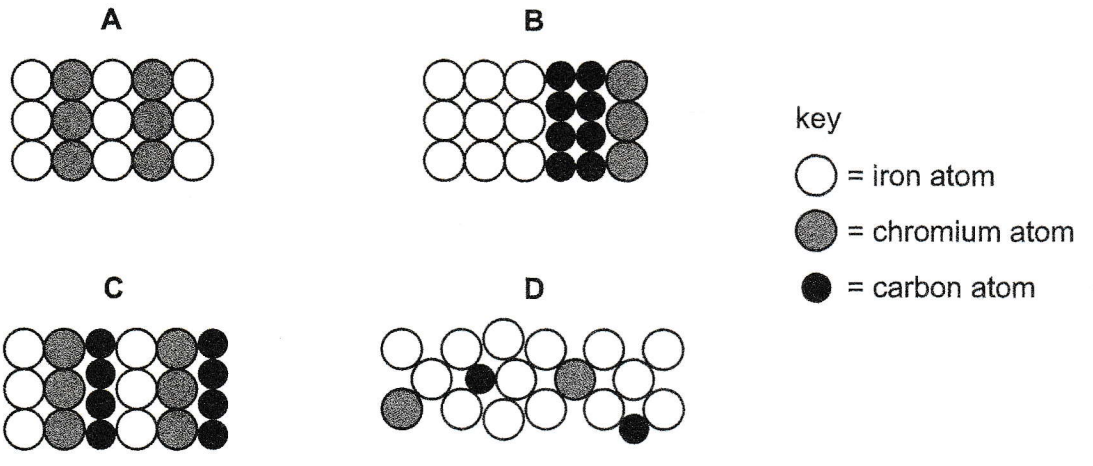
A Iodine displaces bromine from a solution of bromide ions.

B Chlorine, bromine and iodine exist as monoatomic molecules.

C Chlorine displaces iodine from a solution of iodide ions.

D Bromine is a solid, chlorine is a liquid and iodine is a gas at room temperature.

33 Which diagram shows the arrangement of the atoms in stainless steel?



34 Metal W reacts slowly with cold water to produce hydrogen gas.

Metal X reacts slowly with dilute hydrochloric acid to produce hydrogen gas.

When metal Y is added to the salt of metal X, a displacement reaction takes place.

Metal Y does not react with water.

Metal Z does not react with dilute hydrochloric acid.

What is the order of reactivity for W, X, Y and Z?

	least reactive →			most reactive
A	W	Y	X	Z
B	Y	X	W	Z
C	Z	X	Y	W
D	Z	Y	X	W

35 Dry air is a mixture of nitrogen, oxygen, noble gases and carbon dioxide.

What is the correct percentage of nitrogen, oxygen, noble gases and carbon dioxide in dry air?

	percentage of nitrogen /%	percentage of oxygen /%	percentage of noble gases and carbon dioxide /%
A	1	21	78
B	21	78	1
C	78	1	21
D	78	21	1

36 Which pollutant gas is produced by both lightning activity and internal combustion engines?

A carbon monoxide

B nitrogen dioxide

C ozone

D sulfur dioxide

37 Which petroleum fraction is used as a fuel for aircraft engines?

A diesel

B bitumen

C paraffin

D petrol

38 The alkanes are a homologous series of compounds with the general formula C_nH_{2n+2}.

Which row describes the changes as the value of n increases?

	melting point	flammability	viscosity
A	decreases	decreases	decreases
B	decreases	increases	increases
C	increases	decreases	increases
D	increases	increases	decreases

39 A hydrocarbon, $C_{17}H_{36}$, is decomposed during the process of cracking to produce ethene, propene, another hydrocarbon, X, and hydrogen.

The equation for the reaction is shown.

$$C_{17}H_{36} \rightarrow 2C_2H_4 + C_3H_6 + 2X + H_2$$

Which row describes X?

	formula of X	X belongs to the homologous series	effect of X on aqueous bromine
A	C_5H_{10}	alkane	no change
B	C_5H_{10}	alkene	turns colourless
C	$C_{10}H_{20}$	alkene	turns colourless
D	$C_{10}H_{22}$	alkane	no change

40 Which statements about ethanol are correct?

1 It burns completely to produce carbon monoxide and water.

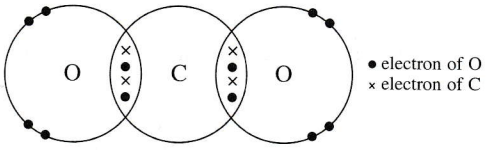
2 It belongs to the homologous series named alcohols.

3 It contains a C = O bond.

4 It is oxidised by potassium manganate(VII).

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

(b) (i)



EXAM TIP:

Carbon atoms and oxygen atoms are bonded by covalent bonds to form carbon dioxide.

(ii) Carbon dioxide is a simple covalent molecule. Small amount of energy is required to overcome the weak intermolecular forces of attraction between the molecules, and thus, carbon dioxide has a low boiling point.

EXAM TIP:

Simple covalent molecules have low boiling points.

(c) $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

Number of moles of CO_2 gas

$= \dfrac{4.0}{12+16+16}$

$= 0.090910$ mol (to 5 s.f.)

Since 1 mol of CO_2 reacts with 1 mol of $CaCO_3$, number of moles of $CaCO_3$ precipitate

$= 0.090910$ mol

Maximum mass of $CaCO_3$ precipitate

$= 0.090910[40 + 12 + 16(3)]$

$= 9.091$ g

$=$ 9.09 g (to 3 s.f.)

EXAM TIP:

Number of moles of substance $= \dfrac{\text{Mass}}{\text{Molar mass}}$;

Mass = Number of moles × Molar mass

October/November 2017 Paper 1

Multiple Choice Questions

21. (C)

Since bromine is at its liquid state at 20 °C, its melting point must be lower than 20 °C, while the boiling point must be higher than 20 °C.

EXAM TIP:

At the melting point, a substance undergoes a change from solid state to liquid state. At the boiling point, a substance undergoes a change from liquid state to gaseous state.

22. (D)

When NaOH(aq) is added, a white precipitate is formed, which is soluble in excess NaOH(aq).

→ The cation present is either Zn^{2+} or Pb^{2+}.

When NH_3(aq) is added, a white precipitate is formed, which is soluble in excess NH_3(aq).

→ The cation present is Zn^{2+}.

When aluminium and aqueous hydroxide is warmed with the solution, alkaline NH_3 is formed.

→ The anion present is NO_3^-.

∴ Compound Z is zinc nitrate.

EXAM TIP:

Recall the test for cations and anions.

23. (A)

The proton number of $^{40}_{19}K$ is 19, therefore the number of protons in the atom is 19. Since an atom contains an equal number of protons and electrons, the number of electrons in the atom is 19. The nucleon number is 40, therefore there are 40 – 19 = 21 neutrons.

EXAM TIP:

The proton number is shown on the bottom left of the chemical symbol while the nucleon number is on the top left.
Number of neutrons = number of nucleons – number of protons.

24. (C)

An ionic compound consists of positively- and negatively-charged ions arranged in a giant lattice structure, has a high melting point, and conducts electricity only in molten or aqueous state but not in solid state.

EXAM TIP:

Sodium chloride consists of Na^+ and Cl^- ions.

25. (B) Fe^{3+} SO_4^{2-}

$Fe_2(SO_4)_3$

$\therefore x = 2, y = 3$

EXAM TIP:

Iron(III) sulfate consists of 2 Fe^{3+} ions and 3 SO_4^{2-} ions.

26. (A)

Number of moles of glucose $= 0.4 \times \dfrac{50}{1000}$

$= 0.02$ mol

Mass of glucose $= 0.02 \times 180$

$= 3.6$ g

∴ 3.6 grams of glucose are added to 50 cm^3 of water to make a solution of concentration 0.4 mol / dm^3.

EXAM TIP:

Number of moles = Concentration × Volume;
Mass = Number of moles × Molar mass

27. (C)

An increase in the temperature of the mixture indicates that energy is given out to the surroundings, and this is an exothermic reaction. Conversely, in an endothermic reaction, energy is taken in from the surroundings, which would cause a decrease in the surrounding temperature.

EXAM TIP:

In an endothermic reaction, energy is taken in from the surroundings. In an exothermic reaction, energy is given out to the surroundings.

28. (D)

EXAM TIP:

During an oxidation reaction, there is loss of hydrogen and loss of electrons.

29. (A)

For the hydrangea to change from blue to pink, an alkaline solution should be added.

(A): Calcium hydroxide is an alkali.

(B): Citric acid is a weak acid.

(C) and (D): Both copper(II) sulfate and sodium chloride are neutral salts.

30. (D)

To prepare an insoluble salt, mix two soluble metal salt solutions. Since both sodium sulfate and barium nitrate salts are soluble in water, when sodium sulfate and barium nitrate solutions are mixed, barium sulfate, which is an insoluble salt, will be produced.

31. (B)

(A) and (B): Elements in the Periodic Table are arranged in order of their proton number, and not nucleon number.

(C): The period number is related to the number of electron shells.

(D): The reactivity of Group I elements increases down the group.

EXAM TIP:

Recall the characteristics of elements in the Periodic Table and the properties of elements in Group I.

32. (C)

Down Group VII, the reactivity of the halogens decreases. Since chlorine is more reactive than iodine, chlorine displaces iodine from a solution of iodide ions. Halogens exist as diatomic molecules. At room temperature, bromine is a liquid, chlorine is a gas and iodine is a solid.

EXAM TIP:

Chlorine, bromine and iodine are elements in Group VII.

33. (D)

Stainless steel is an alloy, in which atoms of different sizes disrupt the orderly arrangement of metal atoms.

34. (C)

A less reactive metal is displaced from its salt solution when a more reactive metal is introduced. Therefore, since displacement reaction takes place when metal Y is added to the salt of metal X, i.e. Y displaces X from its salt, it indicates that Y is more reactive than X. Since Y does not react with water while W does, W is more reactive than Y. Since X reacts with HCl while Z does not, X is more reactive than Z.

$\therefore$ Order of reactivity: Z < X < Y < W

35. (D)

EXAM TIP:

The volume composition of gases present in dry air is approximately 78% nitrogen, 21% oxygen and the remainder (approximately 1%) comprises noble gases (with argon as the main constituent) and carbon dioxide.

36. (B)

Lightning and internal combustion engines cause the formation of nitrogen dioxide. Incomplete combustion of carbon-containing substances causes the formation of carbon monoxide. Exhaust from combustion engines causes the formation of ozone. Sulfur dioxide is produced from volcanoes and combustion of fossil fuels.

37. (C)

EXAM TIP:

Paraffin (kerosene) is used as a fuel for heating, cooking and for aircraft engines. Diesel is used as a fuel for diesel engine; bitumen is used as a fuel for making road surfaces; petrol is used as a fuel for cars.

38. (C)

As the number of carbon atoms (n) increases, the size and mass of the molecules increase. As such, there is an increase in intermolecular forces of attraction which results in greater viscosity. Also, the melting point increases as more energy is required to overcome the stronger intermolecular forces of attraction. Similarly, the amount of energy required for combustion increases as n increases, resulting in a decrease in flammability.

EXAM TIP:

As the number of carbon atoms (n) increases, the alkanes have higher melting point, lower flammability and higher viscosity.

39. (B)

Cracking involves the breakdown of long chain hydrocarbons to produce alkenes and hydrogen.

∴ X is an alkene (C_nH_{2n}). Based on the equation given, we can calculate the number of carbon and hydrogen atoms in X:

$$\text{Number of carbon atoms in X} = \frac{17-2(2)-3}{2}$$
$$= 5$$

$$\text{Number of hydrogen atoms in X} = \frac{36-2(4)-6-2}{2}$$
$$= 10$$

∴ X is C_5H_{10}.

An alkene undergoes addition reaction with aqueous bromine. The reddish-brown bromine turns colourless as it reacts with the alkene.

EXAM TIP:

The general formula of alkanes is C_nH_{2n+2} and the general formula of alkenes is C_nH_{2n}.

40. (D)

Ethanol is an alcohol, with the functional group –OH (does not contain a C = O bond). Ethanol is oxidised by potassium manganate(VII) to form ethanoic acid. Ethanol burns completely to produce carbon dioxide (not carbon monoxide) and water.

October/November 2017 Paper 3

Section A

1.

substance	classification (element, compound or mixture)	atoms within this substance
hydrogen chloride	compound	hydrogen and chlorine
water	**compound**	**hydrogen and oxygen**
steel	**mixture**	**iron and carbon**
air	**mixture**	**nitrogen and oxygen**

EXAM TIP:

An element is a substance that cannot be broken down into simpler substances through any chemical or physical means. A compound is a substance that contains two or more elements which are chemically combined in a fixed ratio. A mixture consists of two or more substances that are mixed together.

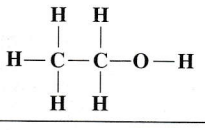
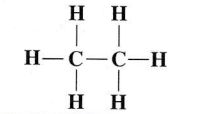
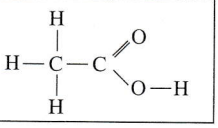
2. **(a)** name of group: Group VII

trend in physical property: The boiling points of the elements in Group VII increase down the group.

(b) name of group: Group I

chemical property: All Group I elements react violently with water.

3.

homologous series	member of series	structure
alcohols	ethanol	
alkanes	ethane	
carboxylic acids	**ethanoic acid**	

EXAM TIP:

The general formula of alcohols is $C_nH_{2n+1}OH$; the general formula of alkanes is C_nH_{2n+2}; the general formula of alkenes is C_nH_{2n}.

4. **(a)** Concentration of solution in g / dm^3

$$= 5.3 \div \frac{25}{1000}$$

$$= \underline{212 \text{ g / dm}^3}$$

Molar mass of $Na_2CO_3 = 2(23) + 12 + 3(16)$
$= 106$

Concentration of solution in mol / dm^3
$= 212 \div 106$
$= \underline{2 \text{ mol / dm}^3}$

EXAM TIP:

$$\text{Concentration of solution in g / dm}^3 = \frac{\text{Mass of compound (g)}}{\text{Volume of solution (dm}^3\text{)}};$$

$$\text{Concentration of solution in mol / dm}^3 = \frac{\text{Concentration of solution in g / dm}^3}{\text{Molar mass of reactant in g / mol}}$$

(b) **(i)** $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

(ii) Number of moles of $Na_2CO_3 = 2 \times \frac{25}{1000}$
$= 0.05$ mol

1 mole of Na_2CO_3 reacts with 2 moles of HCl.

Number of moles of HCl $= 0.05 \times 2$
$= \underline{0.1 \text{ mol}}$

EXAM TIP:

Number of moles = concentration × volume